SnowEx: a NASA airborne campaign leading to a snow satellite mission

SnowEx Team: Edward Kim, Charles Gatebe, Amy Misakonis, Dorothy Hall, Ludovic Brucker, Kelly Elder, Matthew Sturm, Chris Crawford, DK Kang, HP Marshall, Chris Hiemstra, Eugenia De Marco, with contributions by many others

NASA Headquarters Program Manager: Jared Entin

Update: July 7, 2016

Outline

- Welcome & introduction: Ed Kim/C. Gatebe
- Schedule & Logistics – Amy Misakonis
- Site Visit:
  - Kelly Elder/Lead – Ground truth measurement
  - Ludo Brucker - Ground Based Remote Sensing
  - Ed Kim – Airborne Status
- How to get Involved in SnowEx – Jared Entin
- Snow School – Matthew Sturm
- Summary

For more information, see snow.nasa.gov

SCHEDULE STATUS AND RISKS

Amy Misakonis

SnowEx Major Milestones

- Site Visit – Complete
- Fall Deployment – 9/25/16 – 10/4/16
  - Ground Truth
  - ASO
- Winter Aircraft Selection – 7/20/16
- Instruments on Deck @ Aircraft Facility – 12/15/16
- Test Flight – 1/26/17 – 1/30/16
- Winter Deployment
  - Early GT Arrival – 2/1/16
  - Aircraft and GT Campaign – 2/6/17 – 2/24/16
- Final Data Delivery from all Instruments – 6/30/17

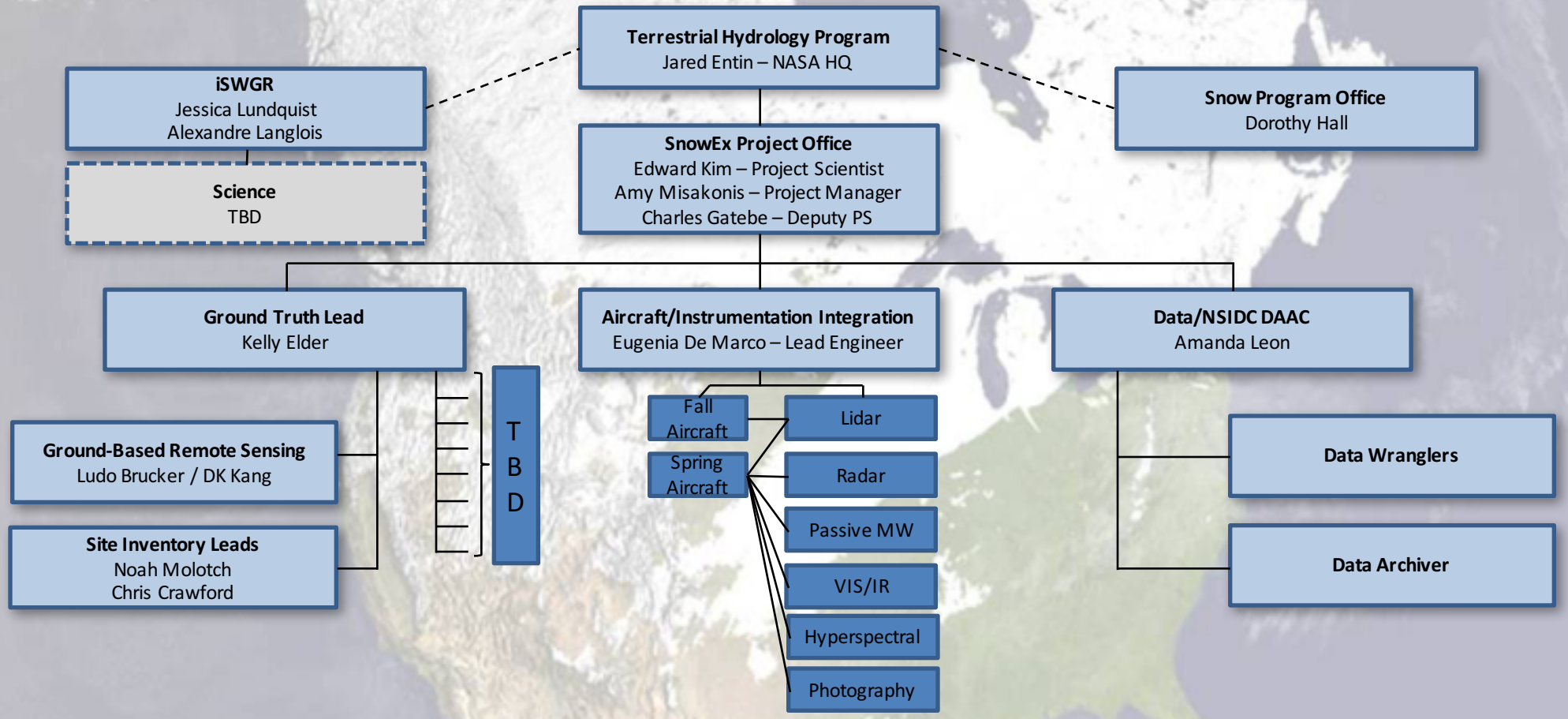
High Priority Activities

- Winter Aircraft Selection
- Ground Truth Budget
- Experiment Plan
- Funding Vehicles
- Call for GT Participation
- Winter Instrument Prep, Test, and Checkout
- GT Procurements
- Fall and Winter Campaign Logistics

SNOWEX ORGANIZATION

Organization Chart and Roles and Responsibilities

SnowEx Project Organization



SnowEx Roles and Responsibilities

- iSWGR Community
  - International Snow Working Group Remote Sensing
  - Provide inputs on mission needs and requirements
  - Provide inputs on science needs and requirements
- NASA HQ – Terrestrial Hydrology Program
  - Provide funding and direction for snow research activities, including SnowEx
- SnowEx Project Office
  - Project Scientist / Deputy
    - Provides technical direction, leadership, and decision making for SnowEx
  - Project Manager
    - Provides project leadership for schedule, budget, meeting mission requirements and objectives, overall mission leadership, responsible for project plan
- Snow Program Office
  - Assist NASA HQ and the Snow Community for snow research activities

- Ground Truth Leads
  - Organize and execute ground truth measurements, including travel and other logistics for ground truth participants
  - Provide feedback/info on site to site inventory leads
- Ground-Based Remote Sensing Instrument Inventory Lead
  - Collect, organize, maintain info on ground-based remote sensing candidate instruments-capabilities and logistical needs
- Aircraft / Instrumentation Lead
  - Lead aircraft feasibility assessments, assist in instrument integration and coordination
  - Assist with flight planning
- Data (archive and distribute SnowEx data)
  - Data Wranglers
    - Provide on-site archiving during deployments
  - Data Archiver
    - Create and maintain archive of all SnowEx data and metadata
    - Interact with SnowEx Project office, iSWGR and snow community to ensure archive meets stakeholder needs

Site Visit (June 26-30)

- In Year 1 the experiment will take place in Western Colorado:
  - Sept. 2016 – Fall/snow-off campaign. Limited observations.
  - Feb. 2017 – Winter/snow-on campaign. Intensive observations.
- **Primary site: Grand Mesa –** Dubbed as the largest flat-topped mountain in the world.
- **Secondary site: Senator Beck Basin Study Area –** a fairly well studied/instrumented watershed.

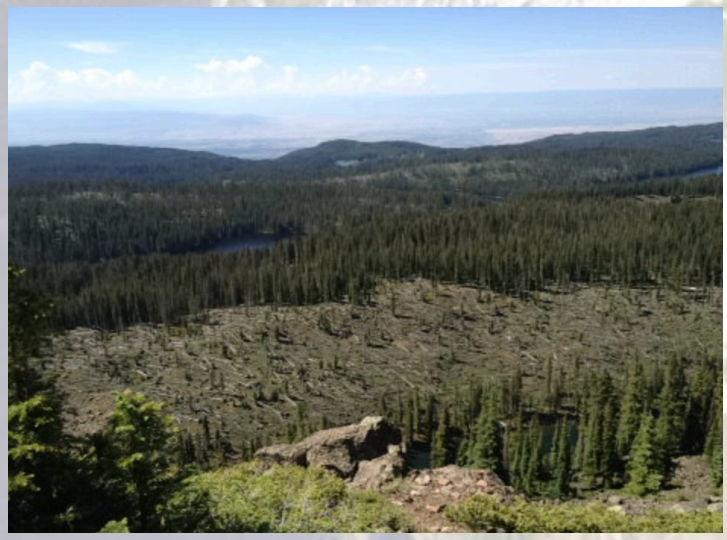
Site Visit June 26-30, 2016

Scenes from Grand Mesa (more pictures at: http://neptune.gsfc.nasa.gov/hsb/index.php?section=381)

A view of Grand Mesa from Grand Juction

SnowEx team enjoying the scenery along the Crag Crest Trail, Grand Mesa, Colorado

Grand Mesa



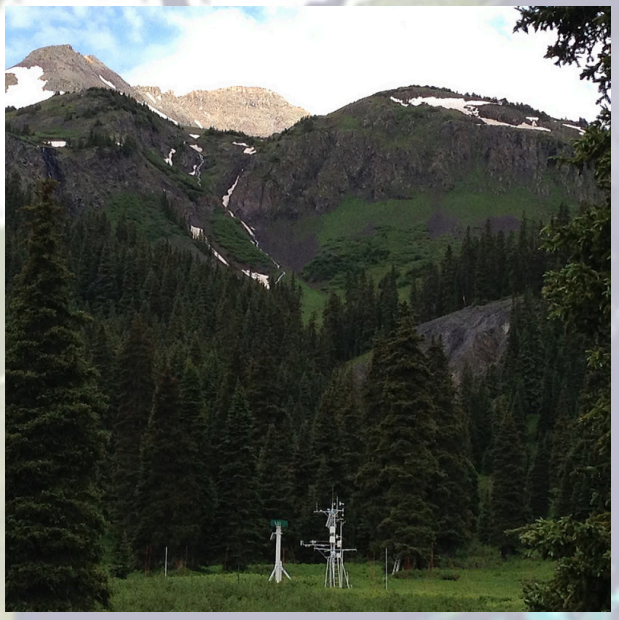
Site Visit June 26-30, 2016

Scenes from Senator Beck (more pictures at: http://neptune.gsfc.nasa.gov/hsb/index.php?section=381)

Looking west towards Senator Beck Basin Study Plot Site

Senator Beck Stream Gauge

SnowEx team looking at the Met Station from the NASA's AERONET sun photometer station at Senator Beck Basin drainage "pour-point."



Swamp Angle Study Plot

SnowEx 2016-2017 - Field Campaign

Initial Ground Team

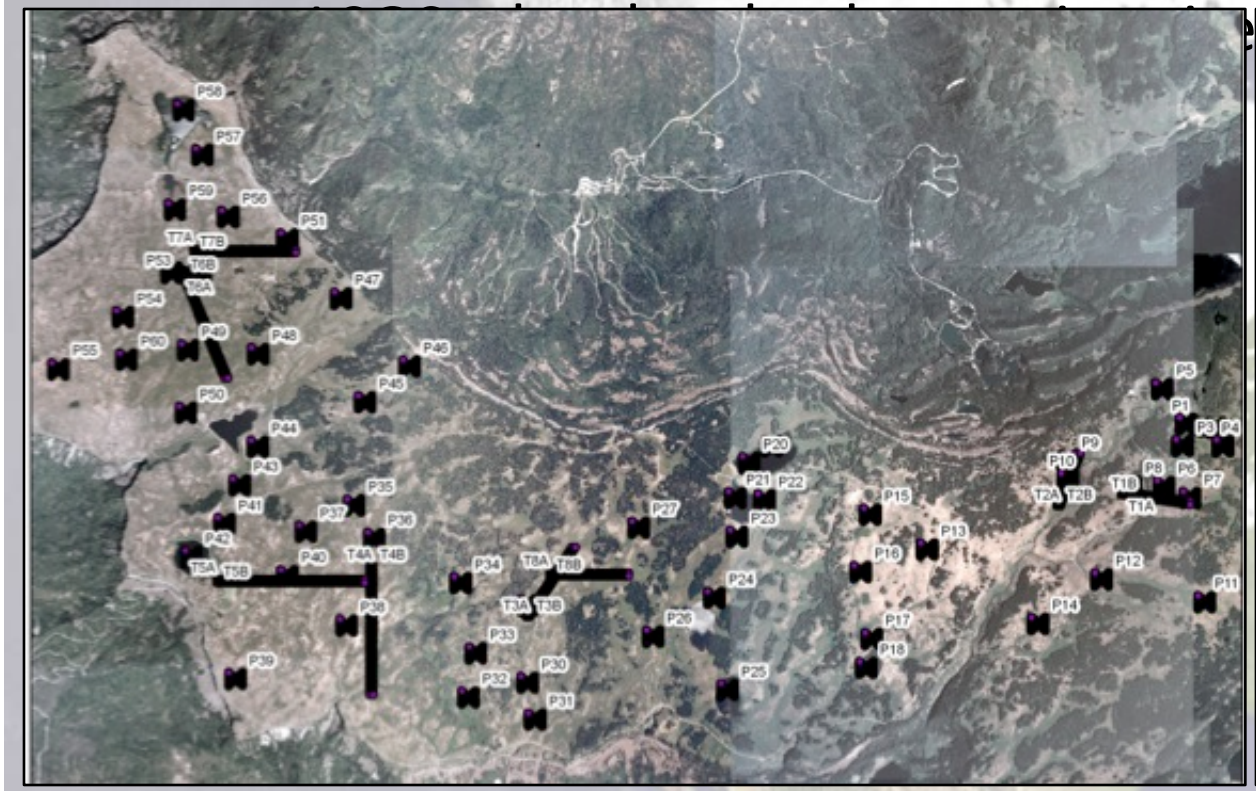
Kelly Elder

Ludovic Brucker – LSOS

HP Marshall – Senator Beck

Chris Hiemstra – Grand Mesa

- Airborne
- Modeling
- Ground Measurements
  - Spatial – large area (~100 km^2)
    - ISA – intensive study area (Grand Mesa, Senator Beck)
  - Local – focused small area (~10,000 m^2)



ISA (Grand Mesa)

LSOS (FEF 2002)

Ground-based Spatial Measurements - Purpose

- Produce a set of high-quality quantitative and qualitative measurements useful in
  - Calibration and validation of remotely sensed data
  - Calibration and validation of models
  - Improving field methods for future campaigns

Study Sites

- Primary site:
  - Grand Mesa, CO
- Secondary site:
  - Senator Beck Basin, CO

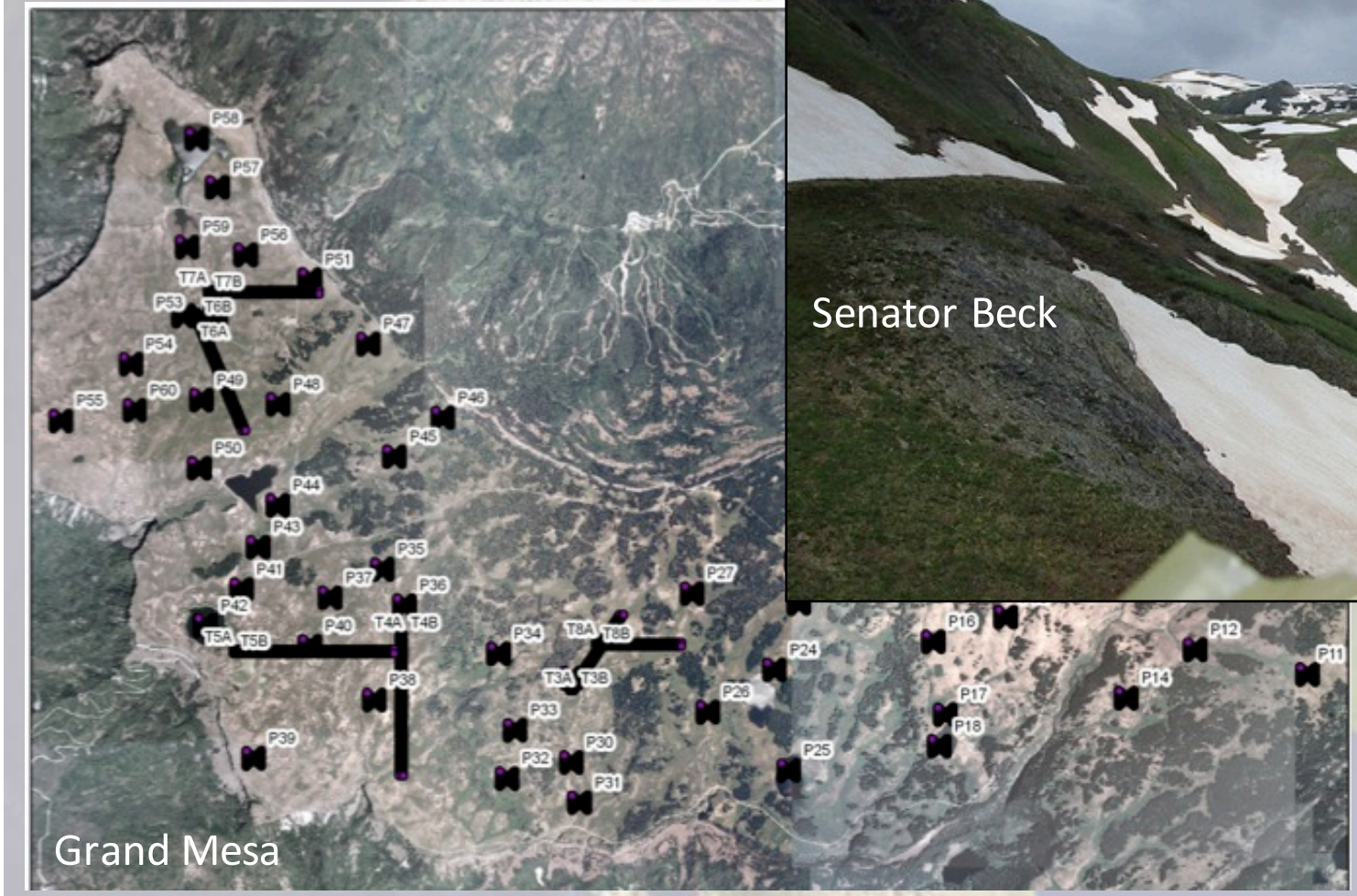


Photo: DK Kang

Fall and Winter Efforts

- Fall - September 26-30, 2016 (proposed dates)
  - Fly LiDar to get no-snow background
  - Collect critical snow-free measurements
  - Collect some vegetation parameters
  - Collect some soil, land use, land cover, etc. data
- Winter – February 6-24, 2017 (proposed dates)
  - Fly *all* airborne sensors
  - Collect critical snow measurements
  - Vegetation or soil measurements?
- Summer (~ 1 week during Jun-Aug, 2017)
  - Fly radar to get no-snow background
  - Collect some soil and vegetation data
- We need your input here!
  - What *must* be measured in order to answer SnowEx questions?
  - What would you *like* to see measured?
  - What tools and resources are needed?

Opportunities to participate in the field

Fall 2016 – relatively small crew

Some hard physical labor – marker installation
Some skilled and unskilled measurements

Winter 2017 – larger crew

Different tasks based on safety and skill
Opportunities to learn, participate, and lead
LSOS measurements – detailed measurements close to home
Group leaders supervising smaller crews - remote locations

Summer 2017 – small crew

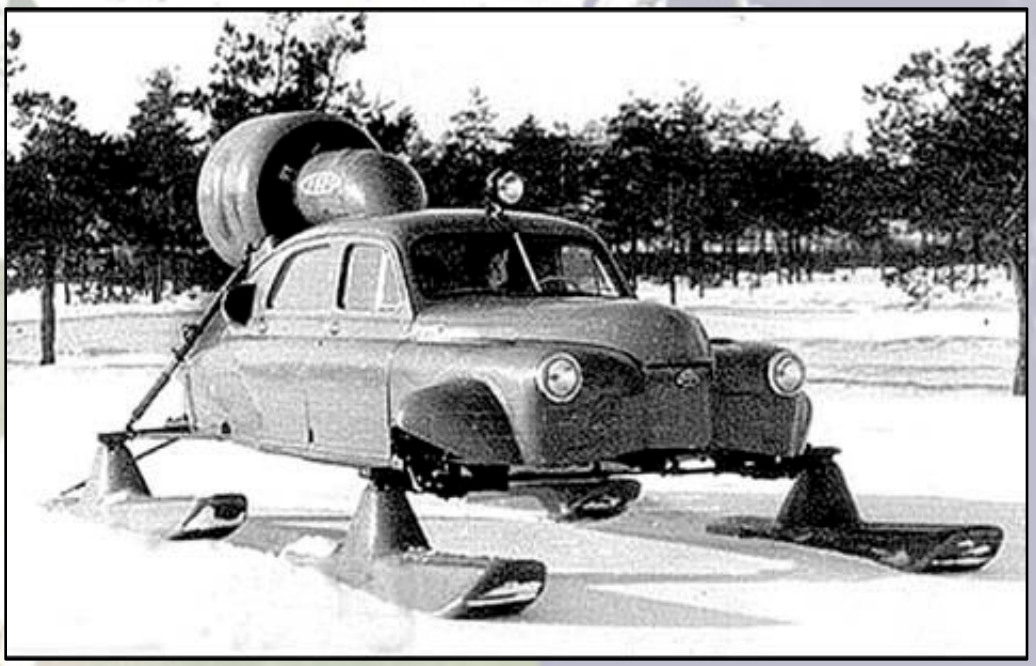
Help collecting round truth for snow-free airborne sensors
Study site decommission – removal of remaining equipment

Senator Beck basin has special considerations relating to safety (avalanches, altitude, extreme weather, etc.) and will be managed differently. If you are interested in working specifically in this location, let us know.

Exact mix and plans for field work will follow safety considerations first, science objectives second.
Science objectives will be modulated by budget, but safety will not

Time for your input!

- Nothing is cast in stone.
- We will have a set of conventional, standard measurements, time and quality tested.
- We are looking for new, innovative methods too.
  - New tools.
  - New sample design.
  - New integrated methods.



Comments, questions, ideas to:
Kelly Elder kelly4SnowEx@gmail.com

SnowEx
Ground Based Remote Sensing

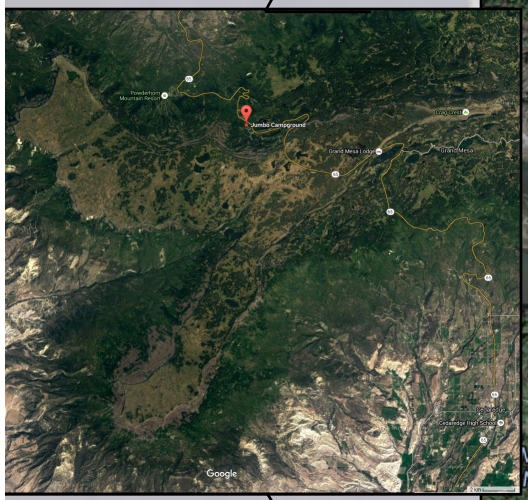
Local Scale Observation Sites (LSOS)

Intensive Observation Period (IOP)

- Ludovic Brucker

Local Scale Observation Sites (LSOS)

An excellent primary candidate site has been identified



Local Scale Observation Sites (LSOS)

An excellent primary candidate site has been identified

Advantages:

. Close to Mesa Lakes Lodge

. Likely access to electricity

. Similar trees as on Grand Mesa

. Plenty of space for snowpit measurements

Of note:

. Site is on Forest Service land

→ permits will be secured

Status:

. Initial contact with Forest Service was made (by Kelly Elder on 6/29)

→ Encouraging outcome

. We are waiting to hear back further guidance from them

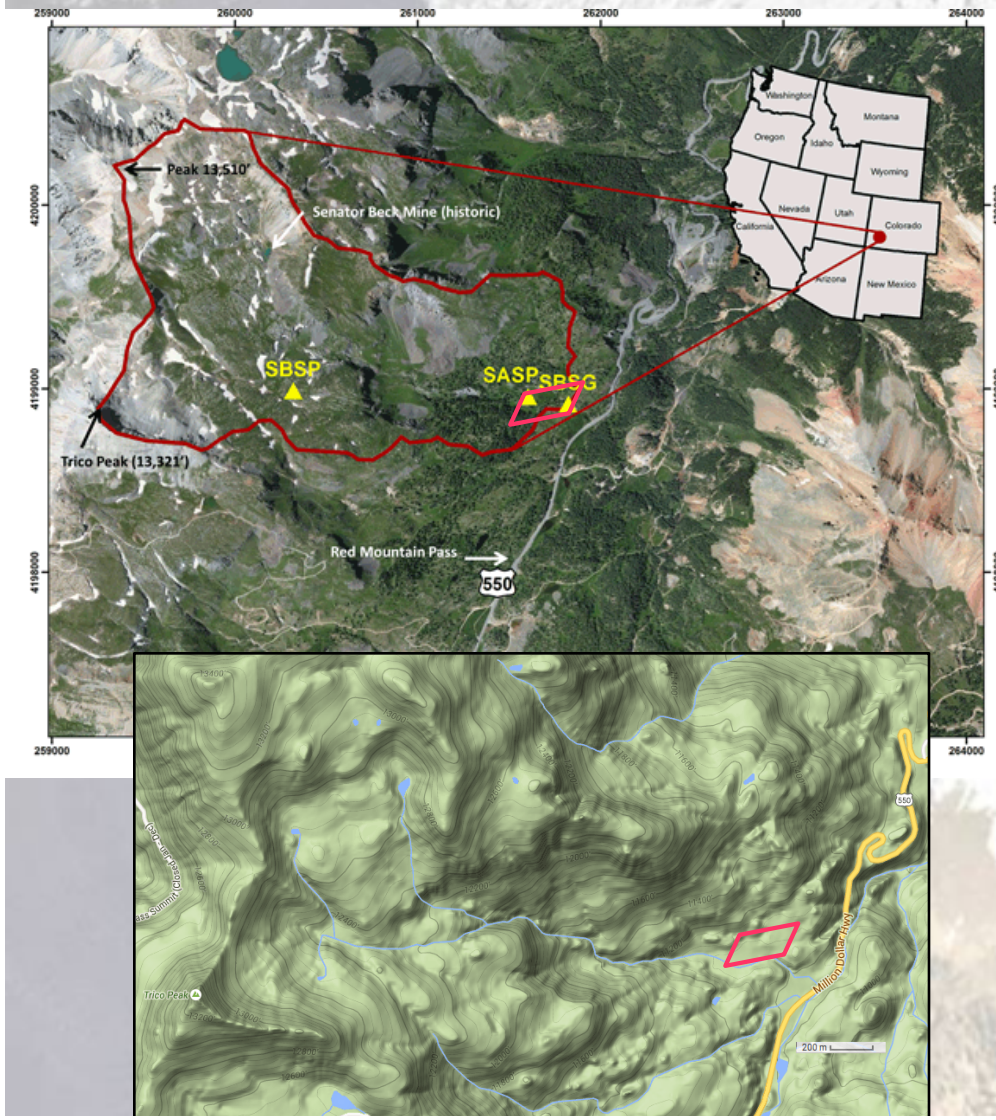
What we need from you (instrument owners):

. To think about the sensors you'd like operated this winter (Oct./Nov. - May)

Local Scale Observation Sites (LSOS)

A good <u>secondary</u> site is at the Swamp Angel Study Plot (SASP) in the lower part of the Senator Beck Basin

www.snowstudies.org/sbbsa1.html



Local Scale Observation Sites (LSOS)

A good secondary site is at the Swamp Angel Study Plot (SASP) in the lower part of the Senator Beck Basin

www.snowstudies.org/sbbsa1.html

Advantages:

. Within the basin
. Flat open area
. Fully instrumented weather station

Of note:

. Everything has to run on batteries/solar panels

Previous ground-based remote sensing activities:

. HP Marshall (BSU) has radars running there
. Tom Painter (JPL) has a sunphotometer (part of AERONET)
. Jeff Deems (NSIDC), Eli Deeb (CREEL) et al. did lidar measurements
. Who and which remote sensing activities did I miss?
    - → email ludovic.brucker@nasa.gov with the type of ground-based remote sensing done

Status:

. Site visit with Jeff Derry (CSAS) on 6/30
    - → very welcoming

Intensive Observation Periods (IOP)

Fall IOP expected date: 1 week in Sept. (26-30, TBC)
Winter IOP expected date: 2-3 weeks in Feb. (6-24, TBC)

Experimental plan:

. Intertwined with the *in situ* implementation plan

→ Kelly and Ludo will work together continuously to produce one document

. Due in August

Key elements of the experimental plan:

. Assess airborne observations (e.g. lidar, radiometer, scatterometer, spectrometer)

. Be coordinated with snowpit measurements

. Extend spatially SD/SWE measurements for airborne algorithm assessments

. Measurements in both open and forested areas

Of note:

. Fall campaign:

- Terrestrial Scanning Lidar
- GPS surveys
- Anything else that may be relevant? Please, let us know

Intensive Observation Periods (IOP)

Fall IOP expected date: 1 week in Sept. (Sept.26-30, TBC)
Winter IOP expected date: 2-3 weeks in Feb. (6-24, TBC)

. A suggestion for the winter campaign: Opportunistic ground-based measurements
Goal: bring together PIs of prototype/innovative instruments during the last few days
+ community building initiative
+ prepare the stage for the second SnowEx

Status:
. Received info sent to DK Kang following RFI sent through the SnowEx distribution list
. Preparation of the form to obtain information from instrument owners

Next steps:
. Finalize the on-line form
. Budget the options that you will submit on-line
. Review most likely via a senior panel (Matthew Sturm, chair)

Ground Based Remote Sensing (LSOS & IOP)

Action items for the community, please:

. Fill out a forthcoming online form no later than July 29
(announcement via SnowEx, iSWGR, and Cryolist)

. Collect all info on your sensors (dimension, weight, power required, autonomy, etc.)

. Think about how do your sensor measurements support the SnowEx science objectives

. Heads-up: it will be critical that the information are complete, answer all the fields describing the sensors.

. If you will propose remote sensing activities in Senator Beck
→ Read the "code of the basin" policy www.snowstudies.org/sbbsa1.html

International snow remote sensing working group (ISWGR): Snow School

ISWGR is an international advocacy group to foster snow community knowledge and activities related to snow remote sensing and is open for anyone interested in joining

To join, email co-chairs Jessica Lundquist or Alex Langlois:
jdlund@u.washington.edu
or
alexandre.langlois2@usherbrooke.ca

URL: http://nasasnowremotesensing.gi.alaska.edu/

- Matthew Sturm

Summary

- Airborne multisensor snow studies are needed over all snow types, forests, etc.
- SnowEx: a NASA airborne campaign leading to a snow satellite mission
  - Instrument payload designed to determine what combination of sensors provides the optimum results for measuring SWE, BRDF, surface temperature and mass
- SnowEx Year 1, 2016-17, will be held in Western Colorado – fall and winter campaigns
- Out years of SnowEx will likely take place in other locations in 2018-19, 2019-20 and 2020-21